CHARACTERISTICS OF ULTRA-NANO-CRYSTALLINE DIAMOND FILMS GROWN ON THE POROUS ANODIC ALUMINA TEMPLATE

Ying-Chieh Chen, Chia-Yun Chen, Nyan-Hwa Tai, Yen-Chih Lee, Su-Jien Lin

Department of Material Science and Engineering, National Tsing-Hua University, Hsin-Chu 300, Taiwan R. O. C.

I-Nan Lin

Department of Physics, Tamkang University, Tamsui 251, Taiwan R. O. C.

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Abstract

Diamond films have been extensively investigated for the applications as electron sources, since diamond has negative electron affinity. The electron field emission behavior of the ultra-nano-crystalline-diamond (UNCD) films was observed to be pronouncedly superior to that of the diamond films with micron- or submicron-sized grains, due to the presence of abundant grain boundaries with sp^2-bonds. To further enhance the electron field emission capacity of diamond films, porous anodic alumina (PAA) assisted growth/etching process was used for increasing the aspect ratio of the UNCD, so as to enhance the field enhancement factor of the emission sites. Porous anodic alumina (PAA) layer was first fabricated on Si substrate, followed by the growth of UNCD. To fabricate the PAA, aluminum films were sputtered onto Si substrate, and were anodized in oxalic acid solution (0.3 M). A two step process was adopted to improve the uniformity of the PAA layer, in which, the first formed anodized layer, the prior oxide layer, was removed and the residual aluminum was then fully oxidized to produce the uniform array of hexagons. After the formation of PAA honeycomb pattern, the UNCD films were grown in a 2.45 GHz microwave plasma enhanced chemical vapor deposition (MPECVD) system, using CH_4/Ar plasma. The morphologies and bonding structures of PAA and diamond films were characterized. The electron field emission behavior of the UNCD films was measured. The correlation of the characteristics of the PAA layer with the characteristics of the UNCD films will be discussed.

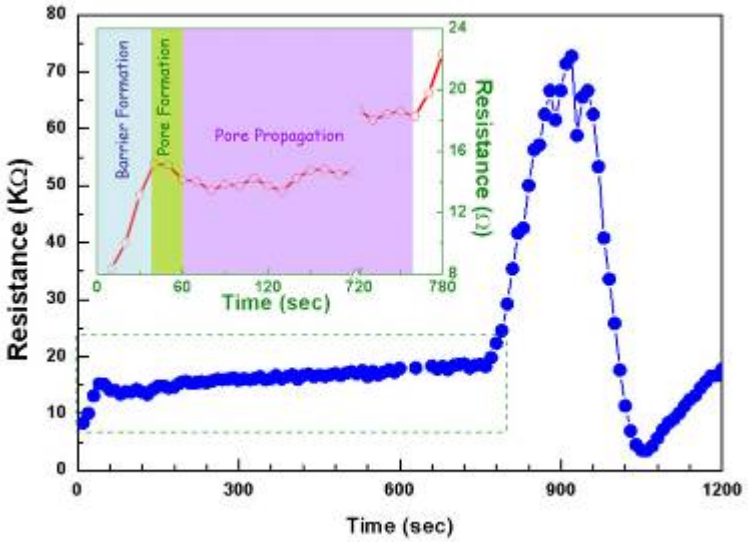

Figure *1*. Two step process for fabrication of porous anodic alumina PAA.

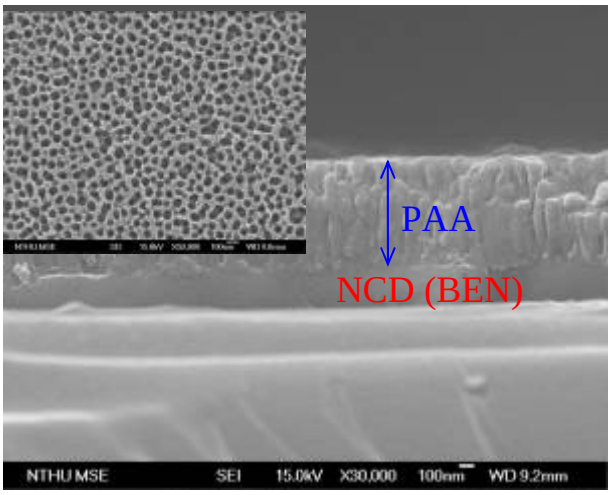

Figure *2*. Typical PAA structure and the ultrananocrystalline-diamond films.

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